NOTE V.

DESCRIPTIONS OF EARTHWORMS.

BY

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VI.

On *Anteus gigas* Perrier.

(Plate 6).

Last year our Museum received a very large earthworm, collected in Brazil by Mr. H. du Dréneuf. I believe the specimen must be identified with *Anteus gigas*, though it does not agree in all its characters with the description given by Perrier of this species [1]). This description was based upon two specimens, one from Cayenne, the other from an unknown locality. Although our worm is not in a very good state of preservation, so that some interesting points of its organisation remained unknown to me, my examination has enabled me to add something to our rather scanty knowledge of this species, and to come to a certain conclusion about the question of its supposed identity with *Microchaeta rappi.*

Vaillant [2]) pointed out that, according to Perrier's description, *Anteus gigas* agrees in many respects, i. e. the arrangement of the setae, the indistinctness of the clitellum, the thick anterior septa, the shape of the nephridia,

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1) Nouv. Archives du Muséum d'hist. natur. de Paris, T. VIII, 1872, p. 49, pl. 1, fig. 13 and 14.

2) Suites à Buffon, Annelés, 1889 (quoted after Benham).

with *Microchaeta rappi* from the Cape, afterwards described by Beddard [1]) and Benham [2]). Though Benham seems to be disposed to join Vaillant's suggestion, he has ranged in his Classification of Earthworms [3]) the genus *Anteus* among the Lumbricidae incertae sedis and concludes his description of this worm with the remark: »it would be exceedingly interesting to investigate more fully the anatomy of *Anteus*, for its locality, Cayenne, is so far removed from the home of *Microchaeta* in South Africa, that it seems scarcely credible that the two are identical."

Our specimen is broken up in two pieces, measuring together 86 cm.; the number of its segments amounts to about 425. Its colour is bluish green, darker at the dorsal side, with a brownish tint on the clitellum. The prostomium is a quadrangular lobe, not embedded in the buccal segment. The two anterior segments are narrow, whilst the eight succeeding ones have about a double longitudinal diameter.

The clitellum commences with the 14th or 15th segment and extends over nineteen segments. Segment 15—28 have a glandular appearance and are separated by obvious intersegmental grooves; on segment 22—27 the edges of the ventral side are thickened and surround a shallow area. Perrier in his specimens observed an obvious glandular modification on the segments 13—29, though he found in segment 8 the epidermis already somewhat thickened and modified; in segment 18—29 there was a projecting ridge on each side of the ventral surface.

The setae (fig. 2) are arranged in four couples; on the 13th segment those of the ventral couples (1 and 2) become separated from each other, and in the middle of the clitellum the distance between them is half as great as the distance between the internal ventral setae of both

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[1]) Transactions of the Zoological Society, Vol. XII, 1886, pl. XIV and XV.

[2]) Quarterly Journal of Microsc. Science, Vol. XXVI, p. 267, pl. XV, XVI and XVI bis.

[3]) loc. cit. Vol. XXXI, p. 265.

sides (1 and 1). In the segments behind the clitellum the setae of each ventral couple become a little closer to each other, whilst the median distance between the internal ventral bristles is somewhat greater. The distance between a ventral and dorsal couple measures about thrice the distance between 1 and 2; the setae of the dorsal couple are placed somewhat closer to one another than those of the ventral couple. In most of the segments of the clitellum and in those in front of it dorsal bristles could not be recognized; in the four anterior segments the ventral setae were also invisible. The setae are not very long, 0.80 mm.; they have the ordinary shape, but are ornamented near their distal ends with several rows of crescent-shaped ridges (fig. 4, *a*). These ridges are much more marked in the clitellar setae (fig. 4, *b*), which are very different in shape and length from the ordinary setae; they are twice and a half as long as the latter (2 mm.) and only slightly curved, want the usual thickened region in the middle, and have their distal end of a lanceolate shape. It may be observed that in the other giant earthworm of Brazil, *Geoscolex maximus* Leuck. 1) (*Titanus brasiliensis* Perr.) 2), the setae in the posterior segments have also a tendency to separate. However, my observations about *Anteus gigas* are not quite in accordance with Perrier's description. According to this author the setae are arranged like in the common earthworm, in four series of pairs, two of them situated quite ventrally, the two others dorsally, the series are constantly parallel to each other from the anterior to the

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1) Zoologische Bruchstücke, Heft II, 1841, p. 104, pl. V.

2) loc. cit. p. 57, pl. 1, fig. 15 and 16.

Rosa, sul *Geoscolex maximus* Leuck., Bollett. dei Musei di Zoologia di Torino, N°. 40, 1888. Perrier afterwards described in his paper on *Pontodrilus* (Archiv. de Zoologie expérim. Vol. IX, 1881, p. 217 and 235) an other species: *Tit. forguesii;* it appears however somewhat dubious to me if this species really belongs to the same genus, because it differs from *Tit. brasiliensis* by having the setae in four series of pairs, by its male pores opening on segment XVII and by the situation of the nephridiopores in front of the dorsal setae.

posterior end of the body, and the bristles of each pair are placed close to each other. Though this difference between my description and that of Perrier may perhaps do arise some doubt about the identity of our specimen with *A. gigas*, I believe our observations agree with one another in so many points to give sufficient grounds for my assertion.

The nephridiopores are very large and apparent in the segments of the clitellum and the posterior region of the body; they are situated in front of the external dorsal setae, the first of them in the intersegmental groove of segment 3 and 4. Dorsal pores are absent. Like Perrier I have not been able to find the orifices of the genital organs.

On opening the worm (fig. 1) we are struck by the immense development of the anterior septa; the 5th to 10th septum are very thick, overlapping one another and hidding totally the intestine and other organs. In the two anterior septa the central portion is carried far backward and has another structure and colour than its peripherical portion; it is of a pale brown colour and appears to be covered with a layer of short prismatical bodies of a fine granular structure, standing vertically on the surface of the septum. In the following septa the central modification spreads out peripherically and reaches the periphery in the ninth septum, giving to it the singular appearance over its whole surface. The tenth septum is not so thick as those in front of it. All these septa are fixed to each other by means of longitudinal muscle-strands. The segments 11, 12 and 13 are covered at their internal side with a brown, horney layer, thicker than the longitudinal muscular layer and showing the same structure as the modified septa. As suggested by Perrier this organisation most give firmness as well as strength to the anterior region of the body for the purpose of burrowing.

The intestinal canal (fig. 2) commences with a large pharynx, the wall of which shows no glandular structures as in many other Lumbricidae; then follows the oesophagus, with a rather wide lumen, which, before passing into the gizzard, shows a wider portion, a specimen of proventriculus. This portion of the digestive tube is situated in front of the first thickened septum (5th), so the gizzard appears to belong to the fifth segment, though lying much farther backward. The tubular intestine then following is furnished in segment 6, 7 and 8 on each side with a large, dark coloured, intestinal gland. Perrier found in his specimen the gizzard situated in segment 6; intestinal glands are not mentioned by him.

The main truncs of the vascular system consist of a dorsal, a ventral and a supra-intestinal vessel. The dorsal vessel is a single tube, which communicates with the ventral trunc by six pairs of commissural vessels in segment 3 to 8; in segment 9, 10 and 11 three pairs of large abdominal hearts (fig. 1, *ah*) are situated, arising from the supra-intestinal vessel, which in the following segments becomes visible on the dorsal surface of the intestinal canal. In this region the dorsal trunc shows a series of large ampullae, and communicates with the supra-intestinal vessel by small vertical vessels, arising from its ventral side. The ampullae of the dorsal trunc are described and figured by Perrier; he found only four pairs of commissural vessels in segment 7—10.

Of the genital organs only the pairs of vesiculae seminales (fig. 1, *vs*) could be recognized; they are not very large and attached to the posterior side of the anterior septum of segment 10 and 11. Perrier found them in the 11th and 12th segment.

The nephridia resemble somewhat those of *Microchaeta* (fig. 3). They consist of a great number of brown-coloured tubules, situated in a longitudinal row close to one another; each tubule forms a loop, the two limbs of which are spirally wound round each other. The whole set of tubules is united by connective tissue and attached to the end of a wide glandular tube, forming a loop which consists of a short limb that descends and a long one that ascends along the row of tubules; the ascending limb forms another U-shaped bend and passes into a long narrow duct communicating with the interior. Neither the internal funnel, nor the manner of communication of the tubules with the main duct could be observed. It is probable that the whole set of tubules form together one continuous duct, as suggested by Benham for *Microchaeta.* Perrier describes the nephridia as: »des organes simplement un peu flexueux, terminés par une sorte de houppe formée par une série de replis membraneux implantés sur sa portion terminale libre. Cette· houppe constitue le pavillon vibratile au milieu duquel s'ouvre le canal." The third nephridium, belonging to segment 5, is modified in an extra-buccal pepto-nephridium (Benham); it consists of a large mass of tubules, covering like a brown gland the whole lateral side of the oesophagus, whilst its main duct forms a loop which extends till near the first nephridium. The communication of Perrier »un oesophage membraneux portant sur ses parois quelques corps glandulaires" no doubt is referable to this organ.

Although our knowledge of the organisation of *Anteus gigas* remains rather incomplete, I believe it may be concluded from the foregoing description, that this species certainly is not identical with *Microchaeta rappi.* This species differs from *Anteus gigas* by the following characters: its setae are very minute and arranged in four couples; its segments consist of a number of annuli, so that it is difficult to limit the anterior somites; its anterior septa, though very strong, are far separated from each other, free from any overlapping; its tubular intestine has only one pair of intestinal glands; its nephridia have a different structure. Perhaps a following fuller investigation will learn us, that both species belong to the same genus, a question which at this moment cannot be settled, because we want any knowledge about the structure of the genital organs. At any rate I believe it can be stated, that there is a close relation between *Anteus*, *Microchaeta* and *Rhinodrilus.*

On the circulation of the blood in earthworms.

In a paper recently published »On *Megascolex coeruleus*" (Quart. Journal of Microsc. Science, Vol. XXXII, p. 49, pl. VI—IX) Mr. A. G. Bourne gives a detailed account of the vascular system of this gigantic earthworm. Upon these observations, partially made in the living animal, the author bases a theory about the probable course of the blood in this worm, and concludes »that throughout the body blood is forced from the contractile vessels into peripherical networks; thence it is conveyed by a system of intestino-tegumentary vessels to intestinal capillaries, and from these it returns to the contractile vessels." It seems to be unknown to Mr. Bourne, that about twelve years ago I put forward the same view as his with regard to the main question of the circulation in earthworms: whence comes the blood into the dorsal vessel? In my paper »Aanteekeningen op de anatomie van *Lumbricus terrestris*" (Tijdschrift der Nederl. Dierkund. Vereeniging. Dl. III, pl. 6) he will find on page 37: »As to the direction of the course of the blood all observers agree in this point, that the blood flows in the dorsal vessel from the posterior extremity forwards, in the commissural vessels from the dorsal side downwards, and in both ventral vessels (supra- and sub-neural vessel) from the anterior extremity backwards. The integumentary vessels are usually considered to be the afferent vessels, the intestinal vessels to be the efferent vessels of the dorsal trunc. Because the skin is the respiratory-apparatus of *Lumbricus*, the dorsal vessel should be supplied with arterial blood and to be considered as a specimen of aorta, whilst the venous blood, coming from the intestinal canal, should flow to the ventral vessel, which therefore should be comparable with the vena cava. This opinion is also maintained and elaborated by Perrier in his detailed description of the circulation in *Urochaeta*. However I cannot agree with this view. First it must be stated, that the vessel *vt'* (a branch of the dorso-integumentary vessel of Bourne) rightly is considered by Perrier himself in *Urochaeta* to be the homologue of the afferent vessel of the dorsal branchiae in Annelida branchiata. Now these branchiae receive always their afferent vessel from the dorsal trunc or its commissural vessels, whilst their efferent vessel joins the ventral trunc. In the vicinity of those branchiae there occur often contractile dilatations of the vessels, which of course tend to surmount the greater resistance, caused by the flowing of the blood through the branchiae. While therefore in the majority of Annelids the dorsal vessel is considered to contain venous blood, that flows in the directions of the branchiae, this should according to Perrier a. o. not be the case in *Lumbricus*, the vascular system of which is constructed on the same pattern."

I believe that Vejdowsky, who agrees with my view that the blood flows from the intestinal capillaries into the dorsal vessel, based his opinion upon the same morphological data, for, on p. 117 of his System und Morphologie der Oligochaeten, he refers to *Alma nilotica*, which is furnished with branchiae in the posterior region of the body; this curious Oligochaeta from the banks of the Nile was first mentioned by Grube (Archiv für Naturgesch. 1855, p. 129, pl. V, fig. 11—15) and later on described by Levinsen under the name of *Digitibranchus niloticus* (Vidensk. Meddel. naturh. Forening i Kjøbenhavn, 1889, p. 321, pl. VII, fig. 7 and 8).

EXPLANATION OF PLATE 6.

Fig. 1. *Anteus gigas* Perrier; general view of the contents of the body cavity, when the body wall has been cut along the dorsal mid-line: *ah.* abdominal heart; *cv.* commissural vessel; *iv.* supra-intestinal vessel; *n.* nephridium; *pn.* extra-buccal pepto-nephridium; *vs.* vesicula seminalis. × 1¼ diam.

Fig. 2. View of the intestinal tract and the setae, after removal of other structures: *g.* gizzard; *gl.* intestinal gland; *oe.* oesophagus.

Fig. 3. Nephridium of the sixth segment. × 3 diam.

Fig. 4. *a.* Ordinary seta; *b.* elongated seta of the clitellum. × 25 diam.

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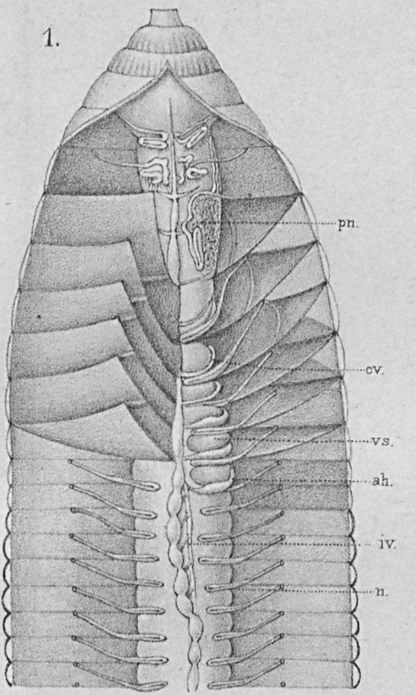
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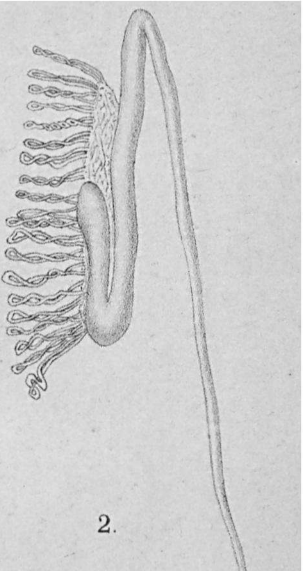

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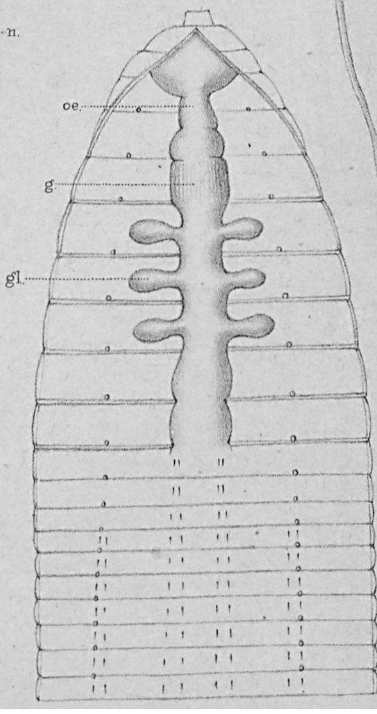

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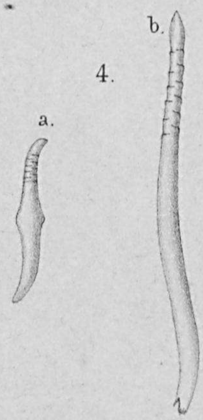

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Anteus gigas *Perrier*.